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IS SEASONAL DIET COMPOSITION OF RED DEER (*CERVUS ELAPHUS*) AFFECTED BY GAME PRESERVATION?

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Summary: In Europe, approx. 280,000 deer, predominantly red deer (*Cervus elaphus*) and fallow deer (*Dama dama*) were kept in game preserves in 2012. Information on foraging habits of fenced populations is important for wildlife management purposes. However, actual knowledge of diet composition of red deer is mainly based on studies of free-ranging deer. Until this time, few specific studies have compared the diet composition of deer living in fenced and unfenced areas. Hence, we aimed to compare how diet composition differs inside and outside a game preserve during the vegetation period. Botanical composition of red deer diet was studied in fenced and unfenced areas of a forested region in Gyarmatpuszta, Hungary. We collected faeces samples in spring, summer and autumn (n=20 for each area and period). Analyses were made by microhistological identification of plant epidermis fragments found in the faeces. Browse species dominated the diet of red deer (40-82%) both, in the fenced and unfenced areas throughout the vegetation period. Oak species (*Quercus spp*.), the common tree of the areas, were always the dominant browse species in the diet (11-53%). The consumption of different shrub species was much lower in the fenced than in unfenced area. Ash (*Fraxinus spp.*), bramble (*Rubus spp.*), black locust (*Robinia pseudoacacia*), dogwood (*Cornus sanguinea*) or rose (*Rosa spp.*) were highly selected by some individuals (15-86%). In turn, supplementary food appeared in a higher proportion in red deer diet in the game preserve than outside. This consumption was dominated by corn in fenced area in summer (21±33%) and autumn (35±14,8%). Grasses and forbs did not exceed 10% of the diet in the most cases. Differences in the diet composition can influence the quality of the individuals (body mass, trophy and venison quality) determining the management success in game preserves. Ongoing and later nutritional analyses of consumed plant materials and venison can reveal such differences.

Key words: supplementary feeding, understory, fenced population, faecal analysis

Introduction

Red deer (*Cervus elaphus*) is a widespread herbivorous game species in Hungary. Stable populations inhabit the diverse habitats of the country from the lowland up to the mountainous areas. The size of the population increased drastically from 1984 (47,500 animals) up to 2000s (approx.69,000 animals) but the low harvest rate did not change (Burbaité and Csányi, 2010). In game preserves, an even larger deer density is maintained to ensure hunting possibilities and venison. Nowadays there are 117 game preserves with 7,126 red deer in Hungary (Csányi, 2012). In Europe, approx. 280,000 deer, predominantly red deer and fallow deer (*Dama dama*) were kept in game preserves in 2012 (EFSA, 2012).

The dense deer populations (and other wild ungulates) in the preserves can have significant negative impact on the natural vegetation. Since the regeneration of the browse species is limited, the role of supplementary feeding (hay-silages, grains, special supplements etc.) becomes much more important. Outside the fenced areas, however, forage supply of the natural vegetation determines primarily the diet composition of red deer. The flexibility in feeding behavior of red deer has been reflected in dietary differences in various natural environments in Europe (Hearney and Jennings, 1983; Homolka, 1990; Bruinderink and Hazebroek, 1995; Mattiello et al., 1997; Gebert and Verheyden-Tixier, 2001; Mátrai et al., 2004). Studies have shown exceptional adaptation of this species to the changes in food availability (Hofmann, 1985).

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Actual knowledge of diet composition of red deer is mainly based on studies of free ranging deer. However, information on foraging habits of fenced populations is also important for wildlife management purposes. But until this time, few specific studies have compared the diet composition of deer living in fenced and unfenced areas. Hence, we aimed to compare how diet composition differs inside and outside game preserve during the vegetation period.

Material and Methods

We conducted our study in a fenced area of 700 ha inhabited by 130 red deer (NGMD, 2012) and a neighbouring unfenced area located in north-central Hungary (Gyarmatpuszta, Bajna Forestry, Park Forest Joint-Stock Company of Pilis). The topography is characterized by gently rolling hills of dolomite and limestone with an average elevation of 300 m. On the lower areas, meadows and agricultural fields of alfalfa (*Medicago sativa*) and cereals, mainly oats (*Secale* spp.) and barley (*Hordeum vulgare*) occur in the valleys.
Fishponds also occur among the hills. Precipitation is 345 mm in the vegetation period, and the annual mean temperature is 9,5 ^{o}C. The dominant tree species are oak (*Quercus spp*.), maple (*Acer spp.*), hornbeam (*Carpinus betulus*), ash (*Fraxinus spp.*) and lime (*Tilia* spp.). Dominant shrubs are maple, elder (*Sambucus nigra*), privet (*Ligustrum vulgare*) and dogwood (*Cornus sanguinea*). However, understory is very scarce in the preserve. In the fenced area, barleycorn, maize grains, pomace and granules made for red deer are fed. Populations of roe deer (*Capreolus capreolus*), mouflon (*Ovis musimon*) and wild boar (*Sus scrofa*) are also present in the study area.

We estimated the botanical composition of red deer diet individually by microhistological analysis of faeces (Holechek et al., 1982; Mátrai and Kabai, 1989) collected in spring (23.05.), summer (01.08.), and autumn (29.10.) 2012 in the fenced and unfenced areas (n=20 in each area and date). We boiled a small quantity of faeces by 40% nitric acid then dispersed the fragments in a drop of glycerin with 0,2% Toluidine-Blue on a microscopic slide. We identified 100 epidermis fragments under a microscope at 260X magnification using a reference collection of plant species (Mátrai et al., 1986). The proportion of diet components was estimated from the number of fragments for a particular forage species or group relative to the total number of fragments. The distinguished categories were as follow: oak (dominant tree species); other browses (leaves, stems of other browse species); bark; forbs (dicotyledonous herbs), grasses (grass and grass like species), seeds (acorn and wild fruits and seeds); supplementary feed (pomace, barleycorn, maize grains and granules).

We evaluated the differences among the proportion of forage groups in a given period and site by Kruskal-Wallis-tests with Dunn's multiple comparison tests. We compared the proportion of different food components within and outside the preserve by t-tests or Mann-Whitney U-tests depending on the normality of the data. We used SPSS 10.0 software package to perform all analysis.

Results and Discussion

We revealed significant differences among the proportion of different food components in each period in both areas ($P<0,001$) (Figure 1). The diet of red deer was dominated by browses (40-82%) all over the vegetation period, both inside and outside. Oak was the most common forage item (11-53%) among browses. In natural environment the browse-dominated deer diet is well-known (Mátrai and Kabai, 1989; Chen et al., 1998; Mátrai et al., 2004; Prokesová, 2004). Grasses and forbs did not exceed 10% of the diet in most cases, except grasses in spring in the preserve (31±22,3%) and in autumn outside (30±16,4 %). Acorn (<10%) was frequent food component inside in autumn (n=18) and outside in summer (n=17). Similarly, bark remains were found in the diet in low proportion (<10%), but frequently in both areas in spring (n=18) and outside in summer (n=12).

The consumption of different shrub species was much lower in the fenced than in unfenced area. Oak and grasses or oak and corn made up the mass of the diet (70-74%) in the fenced area; meanwhile oak, maple, elder, ash, alfalfa, acorn and corn (70-84%) did it in the unfenced area. Experiencing the scarcity of understory food supply in the preserve, we can suppose that fallen leaves of oak in the litter could be a primary food source for red deer. Bark and fallen leaves as alternative diet components appear in the diet when resources are restricted (Borkowski and Furubayashi, 1998; Takahashi and Kaji, 2001).

In a few deer samples in the unfenced area a single forage item dominated the diet. These were privet, rose (*Rosa* spp.), ash, dogwood, black locust (*Robinia pseudoacacia*), and bramble (*Rubus* spp.) among browses (15-86%); alfalfa, marijuana (*Cannabis sativa*), purple loosestrife (*Lythrum salicaria*), milk-vetch (*Astragalus* spp.) among forbs (15-62%) and acorn (21-61%).

In the game preserve supplementary food appeared in a higher proportion in red deer diet than outside. Due to the low availability of natural food supplies supplementary feed could become important food item in the preserve. This consumption was dominated by corn in fenced area in summer (21±33%) and autumn (35±14,8%). Granules were found only in two samples in summer (30 and 54%). This latter can also be due to the interspecific competition with wild boar.

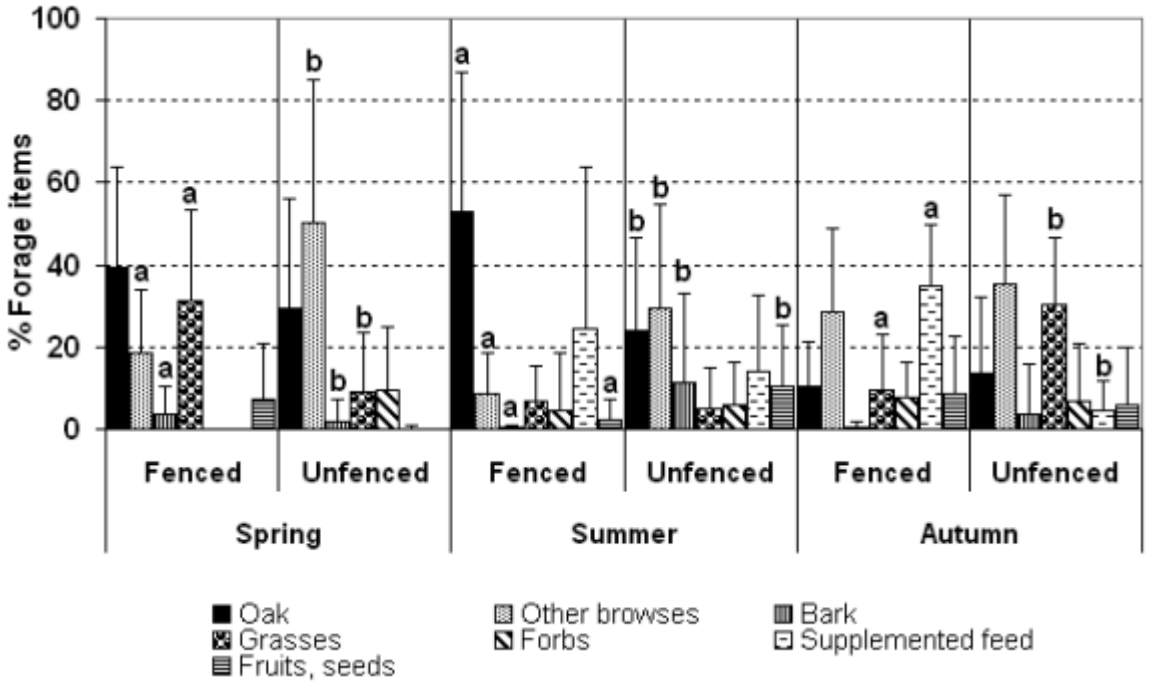

Figure 1. Mean proportion of different forage items (±SD) in red deer diet in fenced and unfenced areas during the vegetation period, Gyarmatpuszta (Hungary) 2012.
Different letters indicate significant difference (P<0,05) between the diet composition of fenced and unfenced deer within seasons.

Conclusion

Diet of red deer living in fenced area can differ from that of the free-living animals even within the same forested region. For wildlife managers the knowledge of the quantitative characteristics of the deer diet in fenced and unfenced areas is essential. Because of the high ungulate impact on vegetation in preserves, deer could generally find richer and more diverse food supply outside than inside the fences. Consequently, there they have opportunity to select browses of higher nutritional values, such as elder and black locust (Mátrai, 1987; Gáborcik et al., 1999; Mátrai et al., 2002). More diverse species composition of the diet in the unfenced area reflects this assumption. As the main conclusion, a game preserve with a dense ungulate population can become a less optimal area for red deer from a dietary aspect, which strongly influences the food selection and diet composition of the individuals and has probably strong effects on the quality of the individuals and the entire population.

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